

### **ABSTRACT OF THE DISCLOSURE**

The present invention provides a method of forming a titanium silicon nitride barrier layer on a semiconductor wafer, comprising the steps of depositing a titanium nitride layer on the semiconductor wafer; plasma-treating the titanium nitride layer in a  $N_2/H_2$  plasma; and exposing the plasma-treated titanium nitride layer to a silane ambient, wherein silicon is incorporated into the titanium nitride layer as silicon nitride thereby forming a titanium silicon nitride barrier layer. Additionally, there is provided a method of improving the barrier performance of a titanium nitride layer comprising the step of introducing silicon into the titanium nitride layer such that the silicon is incorporated into the titanium nitride layer as silicon nitride. Also provided is a method of integrating copper into a semiconductor device and a method of improving copper wettability at a copper/titanium nitride interface in a semiconductor device.